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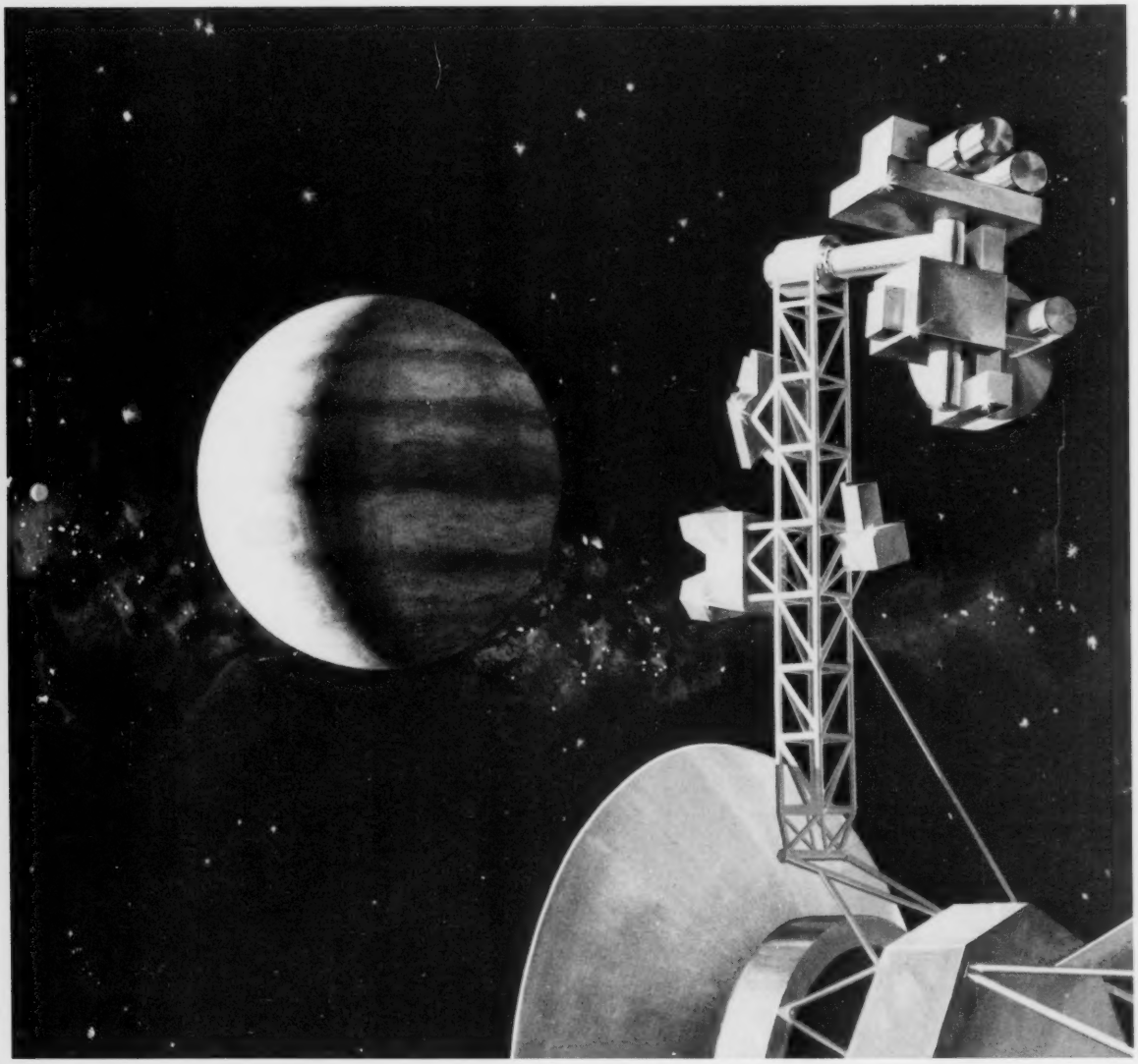

Cover

Beaming in on Jupiter—A Voyager spacecraft aims its instrument scan platform at Jupiter in this painting depicting a major step in the mission to Jupiter and Saturn. Jupiter imaging is expected to begin in December 1978 from a range of 80 million kilometers at an image resolution of 1,500 km. Closest approach to the planet will be on March 5, 1979 when Voyager ranges only 280,000 km from Jupiter. At that point resolution wil be 6 km. Jupiter imaging will be discontinued in April 1979.

Correction—The caption entitled "Huge Wind Tunnel" (page 23, October issue of *Activities*) was incorrect. Last sentence should read: ". . . from the present 370 kilometers per hour to 565 km/hr."

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HEAO-1 Instruments Find Super-radiant Star

A newly found X-ray nova—a gigantic star whose X-ray radiation increases violently over a period of time, then returns to normal—recently was discovered by X-ray sensors aboard the HEAO-1 satellite. The star exchanges clouds of gas so hot that they radiate X-rays 10,000 times stronger than all the combined radiation pouring off the Sun, according to a statement by Dr. Herbert Friedman of the Naval Research Laboratory at Washington, D.C. He is one of the HEAO-1 experimenters.

Located in the constellation Ophiuchucs, adjoining Sagittarius in the north skies far from Earth, the nova is so distant that it is only dimly visible when viewed through our most powerful optical telescopes.

HEAO-1, launched Aug. 12, is the first in a planned series of three unmanned orbital observatories designed to provide scientists with a capability to study X-rays, gamma rays and cosmic rays emitted by stars and star-like objects throughout the universe.

The X-ray nova—near the center of our Galaxy—has increased its emissions by perhaps 500 to 1,000 times its normal luminosity, according to Dr. Daniel Schwartz of the Smithsonian Astrophysical Observatory in Cambridge, Mass., another of the HEAO-1 experimenters.

The nova was first detected by a British satellite, Ariel 5, but the spacecraft did not have the capability to locate the object precisely enough for Earth-based telescopes to pinpoint its position and observe the nova. When the sky-scanning HEAO-1 moved into a position to view the region indicated by the earlier data, more precise location information was gathered by its sophisticated sensors, and made known to ground observatories.

According to Carroll C. Dailey of the Marshall Space Flight Center, optical telescopes in Arizona and Australia were able to locate an extremely dim (18th magnitude) star at the given location, which had not been seen on photographic plates exposed a few weeks earlier.

"This means, of course, that the star increased in the visible light spectrum as well as the X-ray, thus adding confidence in the identification," Daily said. "This is only the fourth time an X-ray nova has been optically identified with a visible star by looking for it through ground-based telescopes on the basis of location data from X-ray detector satellites," he added.

"Scientists still don't know for sure what causes an X-ray nova," he said. "They postulate it could be a binary source, where there's one star orbiting another one, and from time to time a large amount of matter is pulled by gravitational attraction into the nova from its twin, causing the nova to flare up. It's a very complex operation. One of HEAO's objectives is to try to unravel some of these puzzles."

Discovery of the nova is considered by astronomers a very significant finding, Dailey said. "This is exciting to us because this is exactly what HEAO was supposed to do. We hope to make many such identifications, since HEAO has much more capability in this regard than any other satellite ever before orbited."

Approximately 300 X-ray sources in the sky were known to astronomers before HEAO-1 was sent into orbit, he said. "We hope, with the use of this highly sensitive observatory, to eventually increase that number by a factor of 10—that is, up to about 3,000."

The HEAO program is managed for NASA's Office of Space Science by the Marshall center, under the direction of Dr. Fred A. Speer. The spacecraft was built by TRW Corp., of Redondo Beach, Calif. A team of Marshall center and TRW Corp. engineers control HEAO from a control center designed and built by Goddard Space Flight Center engineers.

HEAO-1 Scientists Confer—Early scientific data from NASA's first High Energy Astronomy Observatory launched Aug. 12, recently were reviewed by members of the HEAO-1 science steering committee at a meeting at the Marshall center. Reviewers shown are left to right: Dr. John Meekins, Naval Research Lab; Dr. Elihu Boldt and Frank B. McDonald, Goddard Space Flight Center; Dr. Fred A. Speer, Marshall; Dr. Al Opp, NASA headquarters; Dr. Laurence Peterson, Unievrsity of California at San Diego; and Dr. Hale Bradt, Massachusetts Institute of Technology.

Lunar Science Stations Deactivated

Science instruments left on the lunar surface by the Apollo astronauts ceased operation on Oct. 1 and the Apollo Lunar Science Experiment Packages control center at NASA's Johnson Space Center was dismantled. The stations have completed their scientific objectives and the ALSEP data that can be obtained by continued operation are judged as less important than other projects competition for financial resources, NASA spokesmen said.

Since July 20, 1969, scientists have been receiving a continuous stream of information from the five ALSEPs left on the lunar surface by the Apollo explorers. Much of what has been learned about the Moon has been based on these data.

Five operating stations were in operation, one each for Apollo missions 12, 14, 15, 16 and 17. The Apollo 11 crew placed a prototype station on the lunar surface in July 1969. That first station, with a design life of only 14 days, lasted 45 days and quit because of power supply failure. The remaining five Apollo stations have performed in an outstanding manner.

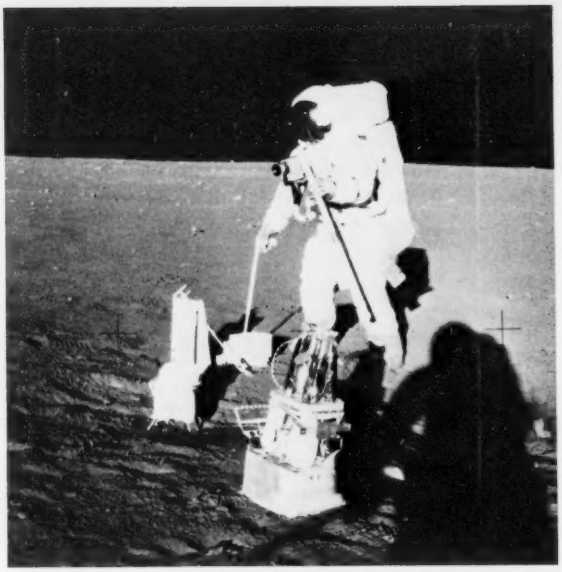
Specifications called for a one-year operating life for the first four ALSEPs and two years for the Apollo 17 station. 1977 marked Apollo 12 ALSEP's eighth year and Apollo 17 ALSEP's fifth year.

More than 153,000 commands were transmitted from Earth and executed by the Moon stations. More than one trillion (10^{12}) bits of lunar science and engineering data have been received on Earth. The total accumulated operating time for all ALSEP stations exceeds 29 years, although the equipment was designed for a cumulative total of only six years.

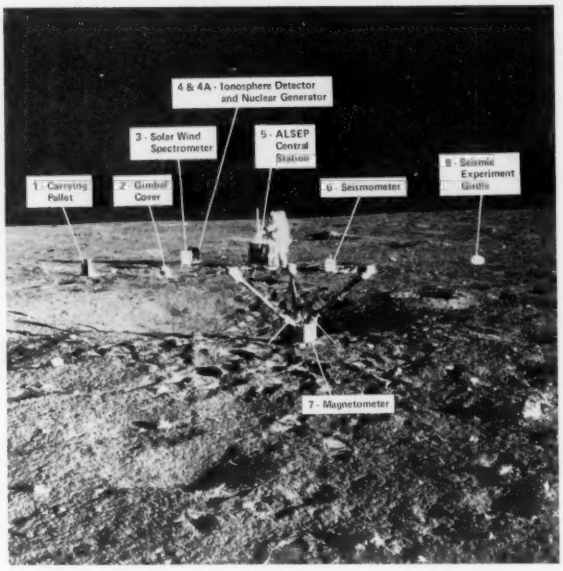
The stations were built to provide long-term lunar surface geophysical and electrical data. The surface experiments included measuring the heat produced by the Moon's interior, the kind and amount of charged particles in the Moon's tenuous ion atmosphere, the magnetic environment, as well as the provision of seismic data on moonquakes and meteoroid impacts.

Because of the extended life of the ALSEP stations, Earth scientists received two extra special bonuses from the science stations: all four seismometers (one each on Apollo 12, 14, 15 and 16) operated as a seismic network for the past five years, which greatly enhanced the analyses of the few large quakes that occur each year on the moon.

Second, a three year accumulation of data from the heat flow experiment was required before scientists became aware of a long term trend in the data. After much thought they realized it was caused by changes in the thermal properties of the soil created by the act



Moon Reading Instruments Set in Place—Astronauts Conrad and Bean, walked on the Moon's surface taking pictures of their landing site, the Ocean of Storms, ALSEP deployment, their lunar module and the Surveyor III spacecraft that soft-landed on the Moon some 2½ years before, in 1967.


4 & 4A - Ionosphere Detector and Nuclear Generator
3 - Solar Wind Spectrometer
5 - ALSEP Central Station
8 - Seismic Experiment Girdle
1 - Carrying Pallet
2 - Gimbal Cover
6 - Seismometer
7 - Magnetometer

ALSEP Deployment, Apollo 12—On the second lunar landing mission Astronauts Charles Conrad, Jr., and Alan L. Bean inspected the many ALSEP instruments emplaced on the Moon.

of emplacing the probes—an understanding that solved the argument between geochemists and geophysicists about the amount of radioactive material in the Moon.

The seismic experiments have been of primary interest to scientists. From information based on moonquakes and meteorite strikes, scientists felt they might finally be able to answer one of the most perplexing questions about the Moon: "What is the deep interior of the Moon like, and does the Moon have a molten core?"

Answers required the data from at least one large (greater than 10^{19} ergs (units of energy)) event on the back side of the Moon, according to Dr. Gary Latham, principal investigator for the ALSEP passive seismic experiment. On May 13, 1972, a front side event with energy of 1,100 kilograms was recorded. On Sept. 19, 1973, a large back side seismic event—with energy of 10^{18} ergs—took place on the Moon. Since then, lunar scientists have been waiting for a third event—"the big one"—but it hasn't happened yet.

The approximate overall scoreboard is: 10,000 moonquakes and 2,000 meteorite impacts.

The past eight years have been a time of tremendous increase in knowledge and understanding of the Moon. The returned lunar samples have played an essential part in this knowledge explosion, but for some aspects of the Moon, only the ALSEPs could have helped.

The ALSEP seismic information, magnetometer and heat flow experiments have contributed most of the information about the Moon's interior. It is now believed the Moon's crust is multi-layered and from 60 to 100 kilometers thick, with the secondary boundary occurring about 20 km deep.

The lunar upper mantle has been determined to be fairly homogeneous and to extend about 500 km. It is believed to consist of olivine or olivine-pyroxene matter, although other compositions also have been proposed. From 500 km (300 mi.) deeper, the seismic data indicate the Moon may be iron-enriched, but data to ascertain whether the Moon has a molten core have been insufficient.

Moonquakes have been discovered to show periodicity and to recur at several places in the interior. The mechanism for this has been hypothesized as release of tidal stress in the region between 1,100 and 1,500 km deep and may occur along possible previously existing faults or local inhomogeneities at depth. The time cycle of the deep-focus moonquakes follows the tidal cycles so closely it appears likely that tidal forces are a major factor in triggering deep-focus moonquakes.

Charged-particle, supra-thermal ion and solar wind experiments also have provided important data for a new understanding of the Earth's magnetosphere and the interaction of the magnetosphere with the solar wind. Ion measurements also detected a lunar surface electric potential of about +10 volts in daylight and about −100 (periodically to −250) volts at night.

These experiments also provided new information concerning the electrostatic lines of force associated with the transition of the terminator across the lunar surface. The phenomenon is thought to be the result of a cloud of hot solar wind electrons near the terminator (the cloud presumably generated by the limb shock of the solar wind).

Extensive lunar soil sputtering resulting from solar wind impingement was also measured by the ALSEPs and further augmented by sample analysis on Earth.

At the end of this fiscal year, the ALSEP stations were left on their own, all but their transmitters muted. Funding for the technical and scientific support needed to maintain the stations ceased Sept. 30, 1977.

Even though the experiments were terminated, the transmitters will continue to serve Earth as a reference point in astronomy. NASA's Jet Propulsion Laboratory will continue to use the signals from the ALSEP transmitters to assist in the labortaory's deep space work including geodetic and astrometric studies and spacecraft navigation. The motion of the lunar orbit also will be accurately monitored against a background of extragalactic radio sources to test gravitational theories.

During the past eight years, many of the instruments associated with each ALSEP station have experienced engineering problems. Since July, engineers at the Johnson center have been performing more than their usual maintenance and engineering fuctions on the ALSEP stations, in preparation for the Oct. 1 shutdown—to extract the last possible ounce of engineering data.

One station in particular, the Apollo 14 ALSEP, has a rather dramatic history of engineering problems. The ALSEP 14 station started working correctly and continued for four years, then it quit for two days in March 1975, and started up again. Then it quit again; then it started up again. This "on-again, off-again" performance was repeated six times in the past two years. The problem has been diagnosed as an intermittent short circuit in one of two power conditioning units, seemingly related to the temperature of the unit, which in turn is related

to the position of the Sun over the lunar landscape.

Over the years the ALSEP program has cost approximately $200 million, including the design and development of the stations themselves, support engineering work in Houston and the science analysis work performed in dozens of university labs throughout the world. The stations cost about $2 million a year to operate. The program has involved hundreds of engineers and scientists and has produced a tremendous source bank of information about the Moon, both as a planet and as an object wading through the electric and magnetic environment of the Earth and Sun.

Bendix Aerospace Corp., Aerospace Systems Division, Ann Arbor, Mich., was prime contractor for the ALSEP equipment and provided technical support for the Johnson center control operations. General Electric Co., Aerospace Group, Valley Forge, Pa., furnished the radioisotope thermoelectric generators which provided electric power. The Johnson center provided project management, operations control and integration; and NASA's Goddard Space Flight Center provided tracking and communications with the stations.

Puerto Rican Student Assigned to Goddard—James Rodriguez, a third year electrical engineering student from Puerto Rico is the first cooperative student to work at NASA from that University. During his work term at Goddard he was assigned to the sensor evaluation branch of the Earth observations systems division, applications directorate, under the supervision of Charles Vermillion. Rodriguez spent the summer learning the techniques for receiving and processing direct readout data from meteorology spacecraft such as the present NOAA weather satellites. He is shown operating the local user terminal for meteorology, a complete ground system that receives real time data from the very high resolution radiometer on NOAA-5 and produces high resolution imagery from that sensor.

Federal Executives Sought for Presidential Exchange Program

High-caliber executives in the GS 13, 14, and 15 levels throughout the Federal government again this year are being sought for the President's Executive Interchange Program. In previous years, five NASA individuals were selected as program participants; in 1977, NASA selected two outside program candidates to work at the space agency.

This unique exchange program arranges for promising executives in the private and the public sector to work for a year—change places, in effect—during the important mid-period of their careers.

Aimed at promoting understanding and a better working relationship between business and government, the program provides the participating executives with an opportunity for professional growth. Each learns at first hand the missions, operations, procedures, potential and limitations of his or her opposite number.

In the eight years since the program was initiated by President Lyndon B. Johnson, some 130 promising executives from the Federal government have been selected as program participants.

To assure the quality of candidates, all nominees must be personally approved by the head of the sponsoring Federal department or agency. The selections are based on an evaluation of leadership, initiative and management ability, a history of on-the-job accomplishment and the potential to become a senior executive in the sponsoring Federal agency of department.

"The benefits to the individual participants, the host and sponsoring organizations and the nation as well are significant." said Jay F. Morris, executive director.

As President Jimmy Carter recently stated, "The President's Executive Interchange Program is a positive force for marshalling our human resources. Through this effort, both the public and private sectors jointly contribute to greater sensitivity and responsiveness in the interest of all Americans."

Qualified government executives or the supervisors of potential interchange candidates should contact their personnel directors or the President's Commission of Personnel Interchange, 1900 E Street NW, Suite 1316, Washington, D.C. 20415; phone (202) 632-6834. Nominations for the 1978/79 interchange year are due in the commission office by Feb. 1, 1978.

Employee Contributions Recognized

Awards totaling $39,800 to seven NASA and two contractor employees have been approved by NASA Administrator, Dr. Robert A. Frosch, in recognition of their contributions to advancing the agency's aerospace program.

The awards, recommended by the NASA Inventions and Contributions Board, cover five major developments: (1) a central timing system for spacecraft tracking stations using coded microwave signals bounced off the surface of the Moon; (2) an improved silica insulation material to protect the Space Shuttle during reentry into the Earth's atmosphere; (3) a tough, temperature-resistant glass coating that covers the Space Shuttle insulation; (4) an economical and durable black chrome coating for solar collectors now in commercial use; and (5) a new optical glass surface that improves the quality of Landsat images.

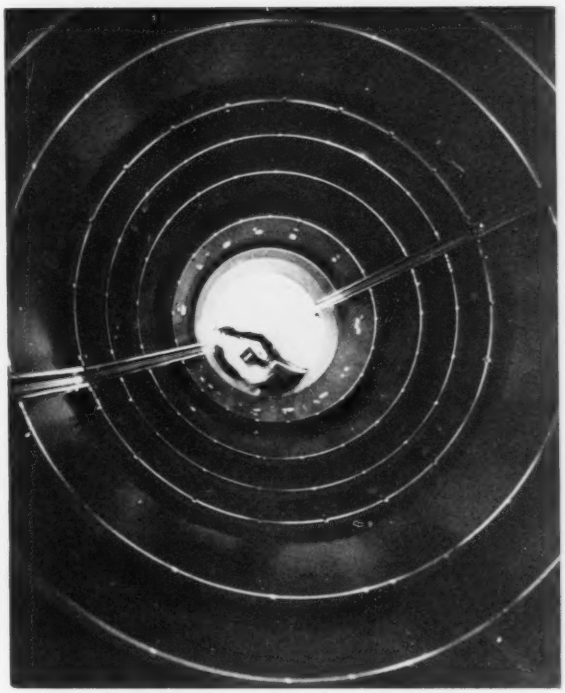
The largest single award, $10,000, was made to Mahlon F. Easterling of NASA's Jet Propulsion Laboratory for development of the central timing system for tracking stations of the Deep Space Network. In use since 1967, the system permits synchronized timing at all the stations, using coded microwave signals bounced off the surface of the Moon from a master station.

The three inventors of the silica insulation being used on the Space Shuttle, each of whom received $4,000, are Howard E. Goldstein and Marnell Smith of NASA's Ames Research Center and Daniel B. Leiser, a former National Research Council Fellow at Ames, now employed at Stanford University. The insulation has mechanical and thermal properties that make it superior to earlier reentry coatings for certain critical areas on the Orbiter's surface. It also is less costly and lighter in weight than the others. Development of the new material helped solve a major Space Shuttle design problem.

Goldstein and Leiser also received $4,000 along with Victor E. Katvala of Ames, as co-inventors of the durable glass coating developed as an added protection for Space Shuttle insulation. The coating, designed to prevent damage to the Shuttle's outside layer when applied over the Shuttle's insulation, provides protection for at least 100 reentry flights. Development of the coating also solved a major technical problem that would have caused a serious delay in development of the Shuttle.

Glenn E. McDonald of NASA's Lewis Research Center was awarded $4,000 for his invention of the black chrome coating for solar collectors. It is described by major commercial users as the most durable and economical coating now available.

Three employees of NASA's Goddard Space Flight Center—Stephen H. Rice, Rodney S. Spencer and Charles M. Fleetwood, Jr.—received $600 as co-inventors of the optical glass surface that improves the quality of Landsat images. The invention involves fabricating an optical glass surface that filters out interference in Landsat images, permitting processing of high-resolution, interference-free photographs. The method has been used successfully by the U.S. Department of Agriculture and will soon be used by the EROS Data Center operated by the U.S. Geological Survey in Sioux Falls, S.D.



Recycling a Space Tool—This welder (at the Lockheed Missiles and Space Co.) and his torch recently began converting $20,000 worth of scrap from an old metal shroud into an $800,000 saving for the American taxpayer. The refurbished nose cone will protect NASA's Seasat-A spacecraft when it is launched next May. After six years of various tests, the old shroud, though still structurally sound, was to be sold for scrap but additional research revealed that it could be converted for usage on Seasat at a saving of nearly $1 million over the cost of a new shroud. NASA's Lewis Research Center awarded the contract for rebuilding the huge metal shroud, which will measure 3 meters in diameter and stand about 13 m high. The picture was taken from inside the cone, framing the welder at the top in a series of circular ribs that add strength to the structure.

First Look at Shuttle External Tank

The first Space Shuttle external propellant tank, the new craft's largest component, rolled off its New Orleans assembly line last September.

A significant milestone in the development of a space transportation system for the 1980's and beyond, the occasion was marked by a ceremony conducted jointly by NASA and Martin Marietta Corp. officials. Guests at the ceremony included leaders from several states involved in Space Shuttle development. About 2,000 persons watched the rollout. The tanks are designed and assembled at NASA's Michoud assembly facility in New Orleans by Martin Marietta under direction of the Shuttle projects office at the Marshall Space Flight Center.

Dr. W. R. Lucas, Marshall center director, noting the significance of the event, said: "The external tank is of first-order importance to the Shuttle system. It not only contains the propellants that operate the main engines, but it also becomes the structural backbone of the system, with both solid rocket boosters and the orbiter attached to it."

Following the ceremony, the huge tank was loaded aboard a barge for shipment to NASA's NSTL in southern Mississippi. There it was installed in a test stand for participation in the first static firing of the Shuttle's cluster of three main engines.

The complete structure is 47 meters long and 8.4 m in diameter. By comparison, the plane-like orbiter is 37.2 m long.

Largest Part of Space Shuttle System—A large crowd was on hand at the Michoud assembly facility in New Orleans to watch the rollout of the Space Shuttle external tank. The tank will hold liquid fuel for the three engines on the *Enterprise* when the Shuttle carries the spacecraft into space in 1979. The tank, the only non-recoverable component of the Space Shuttle, will break up and disintegrate in the atmosphere over the Atlantic Ocean after its fuel is expended.

Civil Service Manpower Cuts Affect NASA

The Office of Management and Budget has asked NASA to reduce its Civil Service complement by 500 positions to reach a new agency ceiling of 23,237 permanent positions by the end of Fiscal Year 1978. The information was received at headquarters in early September.

"Employees at NASA centers throughout the country have been informed by their directors of adjustments to be made at their locations," Dr. Alan M. Lovelace, the agency's Deputy Administrator, said.

"NASA will make the 500-position reduction on the basis of program needs," Lovelace said. "During the past months we have reviewed distribution of manpower throughout NASA against current program commitments and future phasing of work."

On the basis of such reviews, tentatively allocated adjustments for FY 1978 among the agency's centers and facilities show the following personnel reductions and additions:

Ames Research Center	+45
Dryden Flight Research Center	—30
Goddard Space Flight Center	—74
Headquarters	—20
Johnson Space Center	—90
Kennedy Space Center	—80
Langley Research Center	—77
Lewis Research Center	—108
Marshall Space Flight Center	—150
National Space Technology Laboratories	+6
Wallops Flight Center	—5

Some of the considerations that influenced the adjustments in personnel include: consolidation of applications work at three regional centers, including the Ames center, National Space Technology Laboratories and the Goddard center; selective reductions in Civil Service support of space flight programs at the Johnson center, the Kennedy center, and the Marshall center; consolidation of data management activities at the Goddard center; acceleration of transfer of helicopter research and development from the Langley center to the Ames center; adjustments in the staffs of support offices and facilities agency-wide.

"Tentative new center ceilings for FY 78 provide agency management with a modest number of Civil Service positions to accommodate new requirements and to make adjustments to tentative ceilings resulting from a number of agency studies we are planning," Lovelace said.

NASA Satellite Tracks Ditched Balloons

A NASA satellite helped track and pinpoint the location of a two-man balloon that ditched in the cold stormy North Atlantic waters off Iceland to end an attempted trans-Atlantic flight on Sept. 9.

The two balloonists, Maxie Anderson, 44, and Ben Abruzzo, 47, were plucked unharmed from the sea by a U.S. Air Force helicopter after sunset Sept. 12. The balloon and its gondola splashed down 24 kilometers northwest of Iceland, 1,930 km short of its intended landing site in France.

"The satellite tracking data were absolutely invaluable to us. We had lost conventional radio contact when the balloon ran into a snow storm and was blown off course," said Rich Schwoebel, technical director of the flight for the Albuquerque, N.M. balloonists. The balloon, gondola and its launching and tracking equipment were owned and controlled by the two-man crew and their ground support team. The balloon lifted off from a site near Bedford, Mass., carrying a compact satellite tracking unit.

Hopeful Beginning of Balloon Flight—The helium filled balloon, "Eagle," at liftoff from Bar Harbor, Maine. The balloon carried a Nimbus-6 radio-tracking beacon.

Signals from the balloon, transmitted once a minute, were received by NASA's Nimbus-6 meteorological research satellite and relayed to the agency's Goddard Space Flight Center. The balloon's location then was plotted and relayed to the balloon control center in Bedford. Nimbus-6 orbits Earth from pole to pole (south to north in the western hemisphere) once every 108 minutes at an altitude of 965 km.

According to officials at the balloon control center, the balloon ran into trouble off Iceland after a 3,055-km fligh at speeds ranging from 45 to 60 knots.

The satellite tracking beacon is designed for use on weather balloons, buoys and other mobile platforms in remote areas. Temperature, pressure and other environmental data are relayed from instrumentation on the platforms through these beacons. Wind velocity and sea currents are determined from detected movements of the platforms carrying the tracking beacons.

The beacon was used again in early October by Colorado balloonists Dewey Reinhard (pilot) and Steve Stephenson (co-pilot) who attempted a trans-Atlantic crossing from Bar Harbor, Maine. Not only did the Federal Aviation Administration request that they carry the unit for air traffic control purposes and in case of a search and rescue need, but pilot Reinbard declared that he "would not fly without it."

In fact, the Nimbus-6 beacon was able to pinpoint the location of the balloon when Reinhard decided to ditch off Halifax, Nova Scotia, two days after launch. He brought his balloon ("Eagle") down on Oct. 12 because of adverse weather conditions and complications with the ballasting system.

Use of the satellite beacons on the two-man balloon is one in a series of tests to evaluate the devices for application to search and rescue. A light aircraft carried one beacon around the world on a polar flight and a 10-meter sailboat carried another on its 965-km trip through the Bermuda Triangle region east of Florida. Both were tracked successfully by a Nimbus satellite.

Location of a platform carrying the satellite beacon can be determined to within about 3.2 km.

Costs of the satellite tracking beacon on the balloon ventures were incurred by the balloonists. No costs in the experiments are paid by NASA, other than use of the satellite and ground systems which operate on a 24-hour basis in a routine procedure.

Cloud Laboratory to Study Earth Weather

A special weather laboratory that will be carried to space by the Space Shuttle and its Spacelab in the early 1980s to study the causes of weather on Earth is in planning stages. NASA and General Electric Co. (Valley Forge, Pa.) signed a $5.6 million contract to build the laboratory—to be called the "Atmospheric Cloud Physics Laboratory"—in late September. The space agency chose General Electric to negotiate a contract for the work last June.

In the weightless environment of space, this highly sophisticated automated laboratory will be able to perform weather experiments that are impossible on Earth. As we know, years of study have yielded a wealth of data on weather phenomena, but scientists never have been able to satisfactorily study the minute physical processes of cloud formation. Earth's gravity distorts experiments and renders the results incomplete. NASA's cloud laboratory provides ways to allow scientists to fill in some of the blanks.

Charles R. Ellsworth, manager of the cloud physics laboratory task team at NASA's Marshall Space Flight Center, explains two of the problems caused by gravity in Earth-bound laboratories:

"In an experimental cloud chamber on Earth, drops form and fall out of sight so quickly that they cannot be observed properly. In space, without the pull of gravity, the drops form and remain suspended so that the formation process can be observed as long as necessary.

"Convection, or movement of air or fluid, is an effect of gravity that occurs in cloud chambers when temperatures differ, such as when a temperature is higher on one side of the chamber than on the other. This effect distorts the cloud formation procedure. Convection does not occur when there is no gravity. This new laboratory operating in orbit will essentially eliminate problems caused by gravity, and allow scientists to study the microphysical processes of cloud formation without that hindrance."

NASA has selected eight of 26 experiment proposals submitted by the scientific community to be performed in the ACPL on early Spacelab missions. The laboratory will remain in Spacelab during the mission and return to Earth with data from the experiments. The ACPL can be used many times on such missions, giving other scientists an opportunity to carry out different experiments and research leading toward their goal of controlling local weather on Earth.

Scientists whose experiments will be performed on the first mission are:

- Prof. Warren C. Kocmond, executive director of Energy and Atmospheric Environment Center, University of Nevada at Reno.
- Dr. Donald E. Hagen, assistant professor at the Graduate Center for Cloud Physics Research, University of Missouri at Rolla.
- Dr. Patrick Squires, director of the Convective Storms Division, National Center for Atmospheric Research, Boulder, Colo.
- Dr. Bernard J. Anderson, cloud physicist in the Space Sciences Laboratory, Marshall Space Flight Center.

Subsequent missions will be performed:

- Dr. Larry R. Eaton, program scientist for the ACPL Program at General Electric Co., Philadelphia, Pa.
- Dr. Gabor Vali, professor at the Department of Atmospheric Science, University of Wyoming, at Laramie.
- Dr. Clive Saunders, professor in the Physics Department at the University of Manchester England
- Prof. Peter Hobbs, professor in the Atmospheric Sciences Department, University of Washington at Seattle.

New NASA Associate Administrator Named

The appointment of Dr. Anthony J. Calio as NASA's Associate Administrator for Applications became effective Oct. 1, according to NASA Administrator Robert A. Frosch.

"As Associate Administrator for Applications, Dr. Calio is the line official responsible for planning and directing the agency's program to identify and demonstrate the useful application of space science and technology for beneficial use on Earth," Dr. Frosch said.

Previously (since 1975) Calio was deputy associate administrator for the Office of Space Science at NASA headquarters. He joined NASA in 1963, serving first at the electronics research center in Cambridge, Mass., and then at NASA headquarters in the Office of Space Science. In 1968, he transferred to the Johnson Space Center where he served as director of science and applications. Before joining NASA, Calio was employed as a nuclear physicist with the Westinghouse atomic power division in Pittsburgh, Pa.

A native of Philadelphia, Calio received his B.A. in physics from the University of Pennsylvania in 1953. He did graduate work in physics at the University of Pennsylvania and the Carnegie Institute of Technology. In 1974, he received an honorary D.Sc. from the Washington University of St. Louis. He was a Sloan Fellow in 1974-75 at the Stanford University Graduate School of Business.

Among the honors awarded to Calio are the NASA Distinguished Service Medal in 1973; NASA Exceptional Scientific Achievement Medal in 1971; and the NASA Exceptional Service Medal in 1969.

He is a member of the American Association for the Advancement of Science, the American Geophysical Union and the New York Academy of Sciences. He is a fellow of the American Astronautical Society and an associate fellow of the American Institute of Aeronautics and Astronautics.

First Shuttle Payload to Scan Earth Resources

The first 1979 payload to be carried into space by the Space Shuttle will carry out investigations in Earth resources environmental quality and severe storm research.

The payload, under the management of the NASA headquarters Office of Applications, will be on the second orbital flight test (OFT-2) scheduled for launch from the Kennedy Space Center. Space Shuttle orbiter 102—sister ship to the *Enterprise*, which recently underwent approach and landing tests at NASA's Dryden Flight Research Center—will make the first several Shuttle space flights.

The orbital flight test program is a series of six developmental missions in 1979 and 1980 leading to operational readiness of the Space Shuttle in May 1980.

The first orbital Shuttle mission (OFT-1) will carry instrumentation to evaluate its performance (as will other OFT missions) and also will carry a special package called the induced environment contamination monitor (IECM) to measure the effects of the Shuttle on the space immediately around it. The monitor will be carried on all six orbital flight test missions.

The payload, like the Shuttle orbiter itself, is reusable. This will permit adjustment and modification of the payload instruments and other hardware to allow its use in subsequent flights at relatively low cost.

The first Shuttle payload investigations and the principal investigators as currently assigned are:

- **All-Weather Surface Observation Investigation**
  Principal investigator, Dr. Charles Elachi, NASA Jet Propulsion Laboratory

For several years NASA research spacecraft have obtained data about Earth resources through the use of space sensors that see in the visible and near infrared portions of the electromagnetic spectrum. This investigation will extend such observations into the microwave portion of the spectrum.

Using an active microwave system (radar), this investigation will add a valuable new dimension to the earlier data and also will allow observations through cloud cover. Resulting information will be particularly important to mineral exploration on Earth and to regions where clouds are present a large part of the time. The investigation also begins a program to determine the optimum design for active microwave sensors.

- **Measurement of Air Pollution from Satellites.**
  Principal investigator, Dr. Henry G. Reichle, Jr., NASA Langley Research Center.

This investigation will measure the amount and circulation of carbon monoxide in the middle and upper troposphere, representing the first measurement from space of pollutants in the lower atmospheric levels. It is an important step toward measuring and monitoring global pollution where it most directly affects people and communities on Earth.

- **Shuttle Multispectral Infrared Radiometer**
  Principal investigator, Dr. Alexander F.H. Goetz, NASA Jet Propulsion Laboraotry

A special instrument will be used to provide for testing of various combinations of spectral bands and bandwidths in the near-infrared portion of the spectrum. This allows continued research to bring to optimum efficiency infrared sensor systems for future Earth resources satellites. On the OFT-2 mission, the instrument will test spectral bands not now used by the Landsat Earth resources satellite, but which appear to have important applications to exploration of minerals, oil, and gas.

- **Ocean Color Experiment**
  Principal investigator, Hongsuk H. Kim, NASA Goddard Space Flight Center

The bioproductivity of the world ocean is an important indicator of the biological health of our planet and a measurement of the impact of man's activities on its ocean atmosphere. Commercial fisheries use such data to locate and evaluate fishing areas. This investigation will attempt to get bio-productivity data by measuring variations in water color in the open oceans, variations that may identify concentrations of chlorophyll. Chlorophyll concen-

trations often indicate the presence of plankton and algae, which in turn leads to the location of feeding grounds of commercial fish.

- **Nighttime and Daytime Optical Survey of Thunderstorm Lightning and Convective Behavior.**
  Principal investigator, Dr. Bernard Vonnegut, State University of New York, Albany

This investigation will examine the correlation between lightning and various types of severe storms. A standard 16-mm movie camera will be used, equipped with a photocell attachment that records lightning flashes as signals on the sound track of the film. The technique is expected to reveal details of convective circulation in storms and their relationship to the character, location and extent of associated lightning discharges. Data obtained will lead to the development of satellite systems that can identify severe storms day or night.

Spacelab under Discussion—Director General of ESA Roy Gibson discussed Spacelab plans with the Marshall center's Dr. Rick Chappell, mission scientist for Spacelab 1. Chappell is a member of the space sciences laboratory at Marshall.

Selection of Payload Specialists for Spacelab Begins

A promise made years ago to the scientific community by NASA—that its new Space Shuttle would enable scientists to ride up to Earth orbit and actually operate their own equipment—is now in the process of becoming a reality.

The first Spacelab mission, scheduled to fly aboard the Space Shuttle soon after it becomes operational in mid-1980, will have among its crew two "payload specialists," persons selected not by NASA, but by the scientists participating in the Spacelab mission. Since this first mission is a joint venture of NASA and the European Space Agency, one of the payload specialists will be a European.

The selection process to choose the payload specialists has been underway since September. All 19 American candidates were interviewed by Spacelab scientists who met at NASA's Marshall Space Flight Center during the week Sept. 13. Successful candidates' names will be announced in July 1978 by ESA and NASA.

Three of the candidates are women. If selected, one could become the first American woman to venture into space.

Spacelab itself, which fits into the payload bay of the Shuttle, consists of a pressurized module that serves as a laboratory and an outside pallet for instruments that require exposure to space. Payload specialists who will operate the laboratory are unique in several ways—they will be selected and trained specifically for one mission, unlike NASA's permanent astronaut-pilots and astronaut-mission specialists.

Responsibility for flying and maintaining the Space Shuttle vehicle will rest with the astronaut-pilots and astronaut-mission specialists, leaving the payload specialists free to concentrate on the instruments put aboard by scientific investigators whom they represent.

The scientists developing the 42 investigations scheduled for Spacelab 1 are represented by an international committee known as the Investigators Working Group. A part of the working group—the payload specialist selection group—is in charge of the first set of interviews at the Marshall center. The selection group soon will interview candidates in Europe.

In 1978, four payload specialist trainees will finally be chosen. All four will be headquartered and trained at the Marshall center during their training program, scheduled to last about two years. One pair—an American and a European—actually will fly aboard Spacelab 1 to operate experiments of the scientists who selected them. The other two will provide support from the ground control center during the mission.

The Marshall center has management responsibility for NASA in the Spacelab development program and is managing development and integration of scientific payloads on the first three Spacelab missions.

Spacelab, being developed by the European Space Agency, will be carried aloft aboard Space Shuttle spacecraft launched from NASA's Kennedy Space Center. This first Spacelab mission will orbit the Earth

at an altitude of about 250 kilometers. At the end of the seven-day mission the Shuttle will carry Spacelab back to Florida, to be serviced and made ready for another Spacelab mission.

The Spacelab 1 mission emphasizes stratospheric and upper atmospheric research, but research also will be done in plasma physics, biology, medicine, astronomy solor physics, Earth observations and in technology areas such as thermodynamics, materials processing and lubrication.

New Howard University Laboratory Aided by NASA

New facilities for solid state electronics research were dedicated Sept. 20 in ceremonies at Howard University, Washington, D.C. The laboratory was established through a grant from NASA and the Rockwell International Corp. at El Segundo, Calif.

NASA Administrator Dr. Robert A. Frosch was a speaker at the ceremony. He said, "These laboratories which we dedicate today are tools and machines which will help people to build themselves. We anticipate through these laboratories a broadening of our international base, a broadening of our technological ideas and an opportunity for us to have better engineers available to help our whole society."

The space agency provided a $150,000 grant to support the research effort. Rockwell contributed nearly $370,000 in contracts and capital equipment. At present, NASA has 14 research grants with Howard University. The new grant brings the funding total to more than $600,000.

Dr. Eugene M. DeLoatch, Howard's chairman of the electrical engineering department, hopes that research results will advance techniques and equipment employed in satellite and other microwave frequency communication.

Cornell University, Ithaca, N.Y., a leading school in solid state electronic materials research, assisted the D.C. university in establishing the project at the request of the Rockwell Corp.

Dr. James E. Cheek, president of Howard University, presided at the dedication ceremony. "The completion of these laboratories and the initiation of research in this arena, mark the beginning of a new era in electrical engineering education at Howard University," he said.

More than 200 people, from Rockwell, NASA, Cornell University, Energy Research and Development Administration, Bell Laboratories and others representing the public and private sectors, attended the event.

Biology Samples from Russian Space Flight

Two American scientists recently returned to the United States from Moscow with biological samples carried aboard the Soviet biological spacecraft Cosmos 936. The Cosmos mission was the first in which laboratory rats were subjected to artifically produced gravity during weightless space flight.

The biological specimens, along with a radiation measurements package, were distributed for analysis to U.S. laboratories at the University of California at Berkeley, the University of Washington at Seattle, the University of San Francisco, the University of Southern California at Los Angeles, and NASA's Ames Research Center.

The satellite, which the Soviets launched Aug. 3 and recovered Aug. 22, carried seven U.S. biological experiments, as well as exepriments from the Soviet Union, France, Czechoslovakia, Bulgaria, Hungary, East Germany, Poland and Rumania.

The U.S. scientists, Kenneth Souza of the Ames Center and Dr. Eugene Benton of the University of San Francisco, arrived in San Francisco from Moscow Sept. 2 with the specimens. The samples, including bone, muscle and liver tissue from rats and live fruit files had been processed and packaged in dry ice at a mobile laboratory located at the landing site in Siberia and shipped to to Moscow within 36 hours after spacecraft recovery. Souza and Benton were in Moscow to received the sample, supervise proper packaging and carry them back to the United States.

Lewis Center Wins "Best New Products" Awards

NASA's Lewis Research Center was chosen as one of the top winners in the 1977 national "I-R 100" competition, honoring the "100 most significant new technical products of the year." The 100 awards were presented at a black-tie ceremony last September in Chicago's Museum of Science and Industry.

In the contest, sponsored by Industrial Research magazine, Lewis garnered five of the 100 awards, placing second to the General Electric Company (nine awards); and tied with Oak Ridge National Laboratory and Varian Associates, Inc., each with five winners.

In previous competitions the Lewis center won three "I-R 100" awards in 1976. In the 11 years since the center began its participation in the competition, it has taken 21 awards. All 100 of this year's honored

inventions remained on exhibition to the general public at the Chicago museum through Oct. 15.

Lewis inventions cited, and their developers, were:

- An airborne atmospheric sampling system, entered jointly with United Airlines, to measure pollutants in international airways, developed by Porter J. Perkins, Jr., Ted W. Nyland and Marvin W. Tiefermann of Lewis.
- A process for restoring ball and roller bearings, entered jointly with the Army Aviation R&D Command and Industrial Tectonics. Lewis co-developers were members of the bearing, gearing and transmission section, led by Erwin V. Zaretsky.
- A second generation of PMR polyimides, a plastic which has more than doubled the useful life at high temperatures of fiber reinforced plastics, co-developed by Tito T. Serafini and Raymond D. Vannucci of NASA and William B. Alston of the Army Air Mobility Research and Development Laboratory.
- An automatic directional air sampler, called the Air Scout, which monitors air pollutants by type and direction source, developed by Robert B. King, J. Stuart Fordyce, John Toma and James N. Deyo.
- A very lightweight, multi-use, flexible sheet, high voltage capacitor for high electrical storage in small volume, entered jointly with Hughes Aircraft, co-developed by Norman T. Grier and Ira T. Myers of Lewis, and Robert D. Parker, Alfred M. Schwider and Joseph A. Zelik of Hughes.

Lewis Winners from Ohio—Front row (l. to r.): Marvin Tiefermann, Bay Village; Ira Myers, Westlake, Norman Grier, Berea; Raymond Vannucci, Brooklyn Heights; Ted Nyland, N. Olmsted. Back row (l. to r.): John Toma, Parma; James Deyo, Parma Heights; Robert King, Westlake; Porter Perkins, Rocky River; Tito Serafini, Middleburg Heights; and William Alston, Medina.

Hawaiian City Officials Tour Ames Center—Mayor of the City and County of Hawaii Herbert Matayoshi (seated at controls of U-2) with his wife, Mary, and Martin Knutson, chief of airborne missions and applications division (also a U-2 pilot) were briefed on the operation of U-2 controls recently at the Ames Research Center. Mayor Matayoshi also was accompanied by his deputy managing editor and wife, Megumi and Maude Kon during their day-long visit to the NASA center.

EEO Officer Wins Award

The Samuel Cheevers Annual Achievement Award was presented to Roscoe Monroe, a NASA headquarters community relations officer, by the National Technical Association at its recent annual convention meeting in Hampton, Va. Monroe works in the Office of Equal Opportunity Programs at headquarters.

The Cheever Award, the NTA's highest honor, was presented to Monroe for "his continued concern for the role of NTA in the black community and guidance to assure that role is properly filled . . . He has given service of consistently high quality over considerable length of time."

NTA is the oldest black technical association in the world. One of its primary purposes is providing information and opportunities to young blacks in the scientific and technical professions. NTA membership is largely composed of engineers, scientists, educators and architects. The organization was founded in 1925.

Monroe is a regional director for the NTA eastern region, and he has helped form three new NTA chapters since 1974.

Nearly $800,000 Saved by Dryden Pair

A $780,000 savings to NASA's Space Shuttle program has resulted in a $5,000 incentive award for two employees of NASA's Dryden Flight Research Center. John G. McTigue and Stanley Markey shared the award for their role in developing the overland transportation route of the Shuttle orbiter from its Rockwell manufacturing site in Palmdale, Calif., to the Dryden center, where the Shuttle paired aircraft underwent tests from June to October. The original plan called for the Shuttle orbiter to be ferried onboard the 747 Shuttle carrier aircraft from Palmdale to Dryden, which would have required the construction of a mate/demate device at Palmdale at a cost of $2.53 million. Using their extensive knowledge of local terrain, geography and personnel, McTigue and Markey were able to develop a land route which has permitted the orbiter to be trucked to Dryden with relatively minor problems. Cost of the overland route is currently estimated at about $1.7 million compared with the contemplated $2.5 million cost for construction mate/demate device at Palmdale.

World's Largest Solar Cooling System Completed

The island of St. Thomas in the Virgin Islands was the site of a recent solar energy conference and dedication ceremony for the world's largest solar energy cooling system currently in use at the 300-room hotel at Frenchman's Reef.

The completely self-contained hotel, surrounded on three sides by the Atlantic Ocean, had used diesel fuel as its only energy source until the solar energy system was installed. Diesel fuel powers a generator that produces electricity and a desalination plant that provides potable water from the ocean.

The huge $554,000 solar energy system, recently completed and activated, is a part of ERDA's national solar heating and cooling demonstration program. The system's 1,210 square meters of solar collectors, is providing a large portion of the hotel's air conditioning requirements.

Automatically tracking the Sun across the sky, the collectors heat about 1,700 liters of water per minute to about 110 degrees C. This hot water then drives absorption chillers to provide air conditioning. Proprietors of the hotel expect to save about $100,000 per year through use of solar energy instead of diesel fuel to operate the air-conditioning system.

Bob Middleton, an engineer at NASA's Marshall Space Flight Center, Huntsville, Ala., managed the team responsible for design and installation of the system. Middleton said that the solar collectors were designed and installed in a way that does not detract from the beauty of the locale and the hotel.

"This system is unique in that it does not store energy," he said. "It operates the air-conditioning system during the daytime only and the oil-fired steam system takes over at night. We found that this was the most economical system we could build under the circumstances."

The Marshall center, under an agreement between NASA and ERDA, is managing technical design and installation of solar heating, cooling and hot water systems at 59 sites in ERDA's national commercial demonstration program. ERDA provided 75 percent of the funds for the Frenchman's Reef system and the owner, American Motor Inns, paid the remainder of the cost.

Tropical Storm Inundates Space Shuttle Runway, Encourages Ducks

The watery conditions at the normally bone-dry landing site for NASA's Space Shuttle at the 44-acre Rogers Lake Bed in the Mohave Desert grounded the Space Shuttle and caused approach and landing tests to be delayed last August. Tropical storm Doreen struck the desert site of the Dryden Space Flight Center (at Edwards Air Force Base) with such torrents of rain that the lake beds in the region were flooded, and therefore unusable as landing sites for aircraft.

As Edwards AFB personnel described the duck incident, a flock of about 60 mallard ducks became mired in the mud of the normally dry lake bed.

The mallards, which have made the Edwards vicinity their permanent home, found the "new" lake an inviting feeding ground, but their feast—on freshwater shrimp—turned to tragedy as thick mud coated their feet, beaks, eyes and feathers.

"I imagine the ducks were feeding on the freshwater shrimp that appear on the lake after heavy rains," said Joe Rief, the test center's airfield manager. "The lakes have been dry for countless years, but the intermittent rains that occasionally flood them have been enough to keep the shrimp's life cycle going."

No one knew about the duck's plight until a repair crew began working on a runway for the *Enterprise*. By that time, a dozen or so had died, leaving 47 to be saved.

"We were on the lake bed on a Friday afternoon when we found them," Reif said. "I told some of the people in my office about it, and they volunteered to come in on the weekend and try to save the ducks."

An Air Force team saved the 47 mired birds. Said Staff Sergeant Thomas K. Gwin: "We released them at a pond on base, and checked them the next day—they were all healthy and didn't appear to be the worse for their experience. We went back on the lake bed Monday and found five more and managed to save them, too."

"We didn't need special solvents, just a gentle touch and water," Gwin added. "The mud had dried cement-hard on their feet. The balls of clay were so big the birds couldn't fly. Some had it encrusted on their feathers and eyes and several were unable to use their beaks because of caked mud."

"It was a nice way to spend some free time," said S/Sgt. Rodney Jensen. "Ducks are rare in the Mojave, and we need all we can get—or save."

Preparing for Trouble in Space—Astronaut Paul Weitz checks out contingency procedures for jettisoning a jammed Space Shuttle orbiter airlock door, in an exercise performed in the neutral bouyancy simulator at the Marshall center.

Helicopter Structures Conference at Ames

"The Helicopter Today and Tomorrow" was the subject of an address by Dr. Percy A. Pierre, Assistant Secretary of the Army for Research, Development and Acquisition made before the Nov. 16-18 Conference on Helicopter Structures Technology, at NASA's Ames Research Center.

In addition, W. Z. Stepniewski reviewed Soviet helicopter design philosophy as seen in the recent Russian text, "Helicopters" by Tischenko. "Steppy" Stepniewski is an aeronautical consultant in rotary wing technology, who recently completed an English translation of the Russian text.

The conference, sponsored by the western region of the American Helicopter Society and the Ames center, featured specialists in rotor craft structures who reviewed advances in materials and structures and discussed research goals for further development. They also identified current or future programs that could benefit from application of advanced structures technology.

More on How Image Enhancement May Explain Past Events

The following article is reprinted from NASA's Jet Propulsion Laboratory's house magazine, JPL Universe, *dated July 5, 1977.*

In the "truth is stranger than fiction category"—a phone call to NASA's JPL from a member of the Christ Brotherhood in New Mexico, requesting image analysis of a religious relic, has drawn two men from JPL's image processing lab into a fascinating investigation of the famous "Shroud of Turin."

The controversial shroud is a 4½ meter, 7.62 centimeter long linen cloth that bears a remarkably detailed image of a bearded, long-haired man, with numerous lacerations over his body.

Tradition dating back to at least 1354 A.D. has it that the fabric, with its brownish, stain-like shadings, is the burial shroud of Jesus Christ.

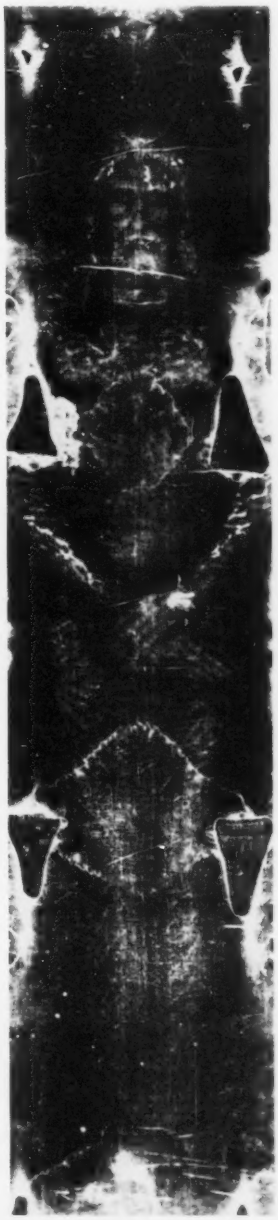
Enshrined in the northern Italian city of Turin since 1578, the shroud has inspired widespread curiosity, especially since the first photographs of it taken in 1898 showed the markings to be a "negative" rather than a "positive" image. The resulting "picture" resembles rubbings made from bas-relief art works.

JPL's Donald Lynn and Jean Lorre were drawn into the quest for further information about the relic when the Christ Brotherhood members and representatives of a New York-based Holy Shroud Guild contacted them last year. These people had learned of the NASA/JPL advanced image processing techniques, and hoped that sophisticated computer analyses might be applied to negatives and color slides of the shroud obtained in 1973. They explained that many questions about various types of marks on the shroud remained unanswered:

Was the body image formed from ammonia vapors absorbed into the linen threads, as thought in earlier years? Was it caused by a radiation phenomenon, as one analysis has indicated, or by processes of which scientists are still unaware? Are the dark spots at the wrists and feet direct-contact blood stains? Is the image possibly a "picture" that was painted on? And how could investigators better distinguish between the original image and blemishes such as holes, wrinkles, and burns, scorching and water stains that damaged the cloth during a fire in the Sainte Chapelle in Chamery in 1532?

The challenge for Lynn and Lorre was in the first phase a technical one, yet both men became caught up in the age-old mystery, and agreed to see what they could do. Their task was to remove as many of the extraneous markings or "artifacts" as possible in an attempt to reveal a more distinct picture of the figure on the shroud.

The pictures they produced (using mathematical and contrast enhancement techniques) revealed a noticeably clearer image of the figure. (See clearly discernible figure in center of accompanying photo. Random white marks are tears and burns.)



"We didn't feel we made any major finds," says Lynn, "partly because we had poor quality negatives to work with. However, frequency analysis did tend to rule out the possibility that the figure was hand painted."

Both men were so optimistic about the mysteries they might eventually solve if allowed to obtain better photographs, that they chose to present their work to the Holy Shroud Conference in Albuquerque last March.

The Albuquerque gathering consisted of 40 participants, including forensic specialists, clergy, scientists from the Air Force Academy, Sandia Laboratory, and the nearby Los Alamos Scientific Laboratory, and eminent Protestant and Catholic scholars, including Vatican representatives.

Their common objective was to share current studies on the relic and to prepare for greater scientific examination of the garment at an unprecedented exhibition of the shroud in Turin in 1978.

The Face of Jesus?—Enlargement of the face of the figure imprinted on the "Shroud of Turin" by image enhancement techniques used at NASA's JPL shows white spots, thought to be bloodstains, on hair and forehead.

That exhibition could be the "moment of truth" for the shroud's authenticity, according to Anglican scholar John A. T. Robinson of Trinity College, Cambridge, especially if use of the destructive carbon-14 dating process (now successful when applied to fragments as small as a square centimeter) is permitted on the fragile fabric.

A report by Dr. John Jackson and Dr. Eric Jumper of the Air Force Academy showed that the figure discernible on the shroud probably was that of a man 5′ 10″ tall, weighing about 175 pounds. These scientists ultimately hope to produce a three-dimensional statue of the body imprint.

One unusual examination by Zurich criminologist Max Frie, indicated that pollen particles found on shroud fibers are indigenous to Palestine, Turkey, France, and Turin, at dates appropriate to the alleged history of the shroud.

Despite the many tests made, scientists at the conference emphasized that they still are at a loss to explain how the image got on the shroud.

That is why Lynn and Lorre want to pursue this project. They'd like to apply color classification analysis such as is used routinely on Earth-orbiting satellite pictures.

"To separate the various markings and determine their nature," says Lorre, "we would need to take high resolution photographs of the shroud in many colors, with adequate calibration controls to allow inter-comparison between the photographs.

"Then very sensitive color variation maps could be produced, which might allow one to separate marks by their chemical composition."

Because of their professional and personal curiosity, Lynn and Lorre are hoping to participate in a more detailed examination and analysis of the shroud before the planned public exposition in Turin in 1978.

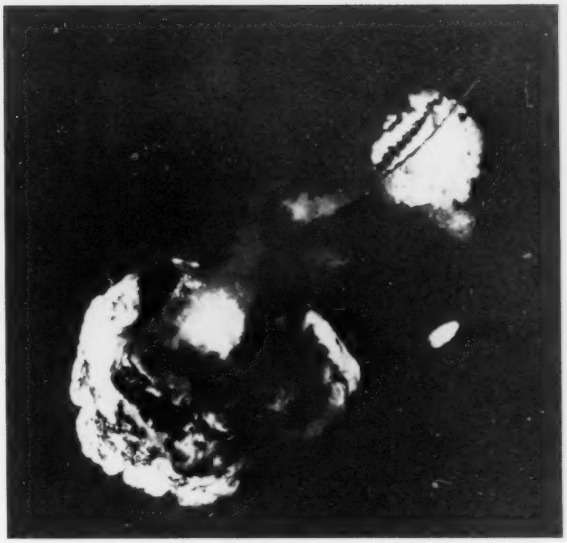
"Everyone who has come in contact with our shroud pictures shares our excitement," says Lynn. "I've observed a level of religious consciousness, especially among lab employees, which I did not know existed.

"Like many people around the world, we'd like answers to these compelling questions. . . . Is this cloth really 2000 years old? Is the image truly the imprint of a human corpse? If so, whose image is it? And, especially from the scientific viewpoint, *how* did that image get there?"

New NASA Publications

Skylab, Classroom in Space (NASA SP401) is based on a project involving 25 high school students from across the United States who were selected in 1972 to participate in the Skylab program from among the 4,000-plus students who had made proposals in the Skylab student project originated by NASA and the National Science Teachers Association. The project was designed to promote the interest and involvement of youth in scientific research and development and use of the resources and unique advantages of space. "Skylab, Classroom in Space" presents information on how the project developed and gives background information on the students who participated. It describes the experiments and relates them to scientific investigations aboard Skylab. Also detailed are a number of science demonstrations performed by the astronauts to illustrate fundamental laws of physics in the weightless atmosphere of the space station. Cloth-bound, 192 pages, for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 for $8.25.

The Apollo-Soyuz Test Project Medical Report (NASA SP-411), compiled by Arnauld E. Nicogossian, M.D., is a publication that represents a partial report on the joint U.S.-USSR Apollo Soyuz Test Project (ASTP). A most compelling portion of this report is concerned with the entry phase of the mission, when the U.S. crewmen were exposed to toxic nitrogen tetroxide gas—fortunately with no serious consequences, thanks to the expertise of the crew's flight surgeons and teams of medical consultants both onboard ship and at the Tripler Army Medical Center, Honolulu, Hawaii. Only two joint U.S.-USSR life sciences experiments were included in the ASTP mission: Microbial Exchange and Zone-Forming Fungi. The medical microbiological analysis of the U.S. crewmembers is reported in chapter 13. The Microbial Exchange Experiment, which includes the data from the USSR cosmonauts, and the other six U.S. science experiments—Quantitative Observation of Light Flash Sensations, Biostack III, Aone-Forming Fungi, Cellular Immune Response, the effects of Space Flight on Polymorphonuclear Leukocytes, and Killifish Hatching and Orientation—are reported in the bibliography. Paperbound, 140 pages. For sale by the National Technical Information Service, Springfield, Virginia 22161, for $6.00.



Spectacular Explosion Marks Unfortunate Event—About 55 seconds into the launch of Intelsat IV-A by an Atlas Centaur rocket, a failure in function of the Atlas stage caused destruction of the space vehicle. Clouds of flame illuminated the skies over the Cape Canaveral launch site.

New Management Education Center Established

A new Management Education Center was opened officially this month by NASA at Wallops Flight Center in Virginia. Dr. Robert A. Frosch, NASA Administrator, presided at dedication ceremonies on Sept. 30. A tour of the new facility preceded the dedication event.

"This facility has been established to provide personnel throughout the agency with unique educational opportunities by offering a variety of instruction," said Mary K. Fortune, director of the office of professional development at NASA headquarters.

"The Management Education Center at Wallops offers a full curriculum of short-term residential programs designed specifically for current and future NASA leaders. The sessions range from three-day seminars to two-week courses in residence."

As a unit of the headquarters office of professional development, the new effort at Wallops will be the agency's focal point for management education.

Did You Know?

Dr. James C. Fletcher, NASA's Administrator from 1971 to May 1977, is now vice president of the National Space Institute. He continues to work in the Washington, D.C. region.

Salyut 5, the Soviet space station home for two crews of cosmonauts during its 16 months of existence, was moved out of its Earth orbit by radio command in mid-August and destroyed over the Pacific Ocean. Tass reported the event. The station, launched on June 23, 1976, was the site of more than 300 experiments.

Attendance records were set at the Alabama Space and Rocket Center at Huntsville, this past summer. More than 48,000 people toured the center in July, an increase of 24 percent over July of last year. Bus tours also set a record for July of 18,842 visitors. Nearly 2 million people have visited the center since it opened in 1970. Of these, nearly half a million also have toured the Marshall Space Flight Center.

Cosmonauts from Poland, Czechoslovakia and East Germany have been in training at the Soviet "Star City" space center just outside Moscow during the first six months of 1977. It is reported that the Soviets will place these non-Soviet spacemen into orbit late in 1978 after about 18 months of training.

Former Astronaut Wally Schirra administered closed heart massage to an unconscious 4-year-old-girl who was removed to an emergency helicopter after nearly drowning in a swimming pool in Colorado. Schirra, who learned bio-medicine during Gemini flights, revived the child, who was then hospitalized.

The Kennedy Space Center recently was the site for an installment of popular television show "The Six Million Dollar Man." Its star, Lee Majors, with a 70-member crew from Universal Studios, spent 10 days shooting scenes at the center and in Cocoa Beach.

The Smithsonian Institution's National Air and Space Museum, now just a bit over a year old, has been Washington, D.C.'s biggest tourist attraction for some time. Recently the museum welcomed its 10 millionth visitor just 53 weeks after opening, and it entertained more than two million additional tourists by the end of summer.

The Peoples Republic of China recently became the 98th member of the International Telecommunications Satellite organization (INTELSAT). This remarkable worldwide system is governed by a board of member nations and operates on a profit-and-loss basis, which makes it unusual that a Communist country should join it. INTELSAT links every corner of the globe through use of five satellites in synchronous orbit at an altitude of 35,784 kilometers. ■ ■ ■

Contractor News

The Boeing Commercial Airplane Co., a division of the Seattle Boeing Co., has won a contract to demonstrate technology for advanced composite horizontal stabilizers for the B-737 transport aircraft. Costs will be shared—NASA will contribute about $11.7 million and Boeing about $1.3 million.

Twin study contracts have been negotiated with the **Lockheed-George Co.,** Marietta, Ga.; and with the **Douglas Aircraft Co.** of Los Angeles. The two firms are being asked to examine complex air cargo problems related to a Langley Research Center study of cargo/logistics airlift systems. Many other organizations are contributing to the work, to be accomplished over four years, including: Trans World Airlines of New York; the two consulting firms, Equipment Interchange Assn., of Washington, D.C. and D. L. Paden and Associates of Berwyn, Pa.; the Flying Tiger Line, Inc. of Los Angeles; the Department of Transportation, Federal Aviation Administration, Department of Defense; and airframe manufacturers, major air shippers, commercial airlines and freight forwarders.

The Martin Marietta Corp. of Denver, and the **Ball Brothers Research Corp. of Boulder** (Colo.) have been chosen for negotiations of fixed price contracts to conduct parallel Shuttle tethered satellite system definition studies. Each study is estimated to cost about $290,000. The primary purpose of the tethered satellite would be to gain scientific data from the Earth's upper atmosphere for global mapping of the Earth's magnetic and gravity fields, and studies of atmospheric or plasma physics.

The Hughes Aircraft Co., Space and Communications Group based at El Segundo, Calif., has been selected for negotiation of a contract for about $33 million to build, test and deliver three Geostationary Operational Environmental Satellites (GOES-D, E and F). Project management of the GOES system is assigned to NASA's Goddard Space Flight Center. The spacecraft are developed and obtained by NASA on a reimbursable basis for the National Oceanic and

Atmospheric Administration, which operates the spacecraft after launch and checkout by NASA.

The RCA Service Co. of Camden, N.J. has been chosen for negotiation leading to award of a contract to provide electronics fabrication support services, beginning in January 1978 to NASA's Langley center. Most of the work under the $3.5 million contract will be performed at the RCA plant in Hampton, Va.; some of the work will be done at Langley.

Ball Brothers Research Corp. of Boulder, Colo. has been selected for the final negotiation of a contract for a telescope system for the infrared astronomy satellite project. The contractor's proposed cost, exclusive of fee, is about $13.8 million. IRAS is a cooperative U.S.-Netherlands space project whose mission is to perform an infrared survey of the entire celestial sphere. NASA's Ames Research Center has responsibility for the telescope system; NASA's Jet Propulsion Laboratory has overall U.S. project management responsibility.

McDonnell Douglas Astronautics Co. of Huntington Beach, Calif., has won a $9 million contract for delivery of a series of spinning solid upper stage missions for the U.S. Space Transportation System. The contract was in response to a request for bids issued in May by the Marshall Space Flight Center.

The Lockheed-California Co., a division of the Lockheed Aircraft Corp. of Burbank, Calif., has won a contract to demonstrate technology for the manufacture of advanced composite ailerons for the L-1011 transport aircraft. Costs will be shared. NASA will contribute about $5.85 million and Lockheed about $650,000. Managed by the Langley center, the development effort required will be performed over a four-year period. Lockheed has teamed with the AVCO Corp., Aerostructures Division at Nashville, Tenn., to develop the composite ailerons. The work comes under the NASA program involved with increasing fuel efficiency of future civil transports by some 50 percent. ■ ■ ■

Women in Training at NASA Center—The Wallops Flight Center is one of many NASA installations where women are supplementing their academic training with on-the-job experience in various occupations. This kind of training is provided through cooperative education programs. Seen in this mosaic photograph are: (upper left) Darlene Brummel, who works with the television systems group, lives at Oxford, Md., and studies architectural engineering at the University of Maryland; (upper right) Marian Fecteau, a student at the Eastern Shore Community College and a resident of Chincoteague, Va., working with the payload integration and test group; (left center) Betty Beasley, with the Wallops television systems group, lives in Melfa, Va., and attends the Eastern Shore Community College; (right center) Janice Morris, working in the personnel branch, studies business administration at the University of Maryland and lives at Salisbury, Md.; (frame in center) Ruth Graham, an aerospace engineering student at North Carolina State and a resident of Greensboro, N.C., works at the launch complex; (lower left) Martha Cox, working with the airborne oceanographic lidar project team, comes from Eden, Md., and attends the University of Maryland; (lower right) Beth Dayton, a mechanical engineering student at the University of New Mexico, also works with the oceanographic team.

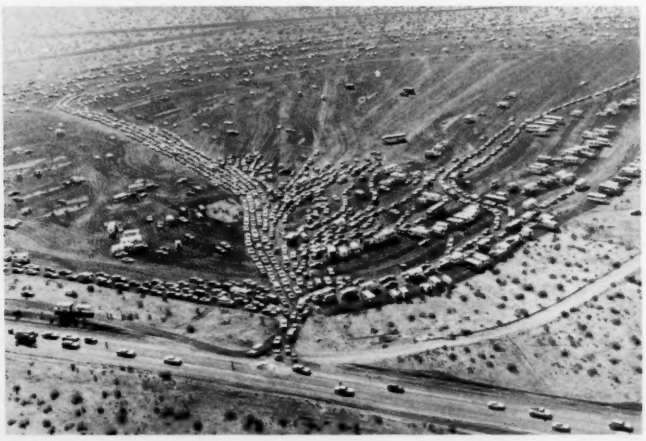
Launches for 1977—Complete and Projected

Name	Launch Date	Vehicle	Range	Mission Remarks
NATO-3 B	Jan. 27	Delta	ETR	Second communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable.
Palapa-2	March 10	Delta	ETR	Back-up satellite for Indonesian domestic communications network. Reimbursable.
GEOS/ESA	April 20	Delta	ETR	ESA spacecraft to conduct scientific investigation of waves and particles in magnetosphere. Reimbursable. Failed to reach correct orbit.
Intelsat IVA-C	May 26	Atlas/Cen.	ETR	Improved communications satellite for Comsat. Reimbursable.
GOES/NOAA	June 16	Delta	ETR	Second operational satellite to provide continuous daytime and nighttime global cloud cover observations for NOAA. Reimbursable.
GMS-Japan	July 14	Delta	ETR	Geosynchronous Meteorological Satellite. Japanese portion of global network of geostationary environmental satellites. Reimbursable.
HEAO-A	Aug. 12	Atlas/Cen.	ETR	High Energy Astronomical Observatory to study energetic radiation from space.
SIRIO-I	Aug. 17	Delta	ETR	Italian project to investigate radio propagation, trapped radiation flux, magnetic field intensity and variation, and the primary electron energy spectrum. Reimbursable.
Voyager 2	Aug. 20	Titan III Centaur	ETR	Jupiter and Saturn planetary systems and the interplanetary medium out to Saturn.
Voyager 1	Sept. 5	Titan III Centaur	ETR	Same as above.
OTS/ESA	Sept. 13	Delta	ETR	Orbital Test Satellite. ESA experimental communication satellite. Reimbursable. Launch failed.
Intelsat IVA-D	Sept. 29	Atlas/Cen.	ETR	Follow-on series of improved communications satellites for Comsat. Rocket exploded 55 seconds into flight.
Navy Transit	Oct. 27	Scout	WTR	Navy navigation satellite. Reimbursable.
ISEE-A/B	Oct. 22	Delta	ETR	NASA's international Sun-Earth explorer.
Intelsat IVA-E	Nov. 10	Atlas/Cen.	ETR	Follow-on earlier Intelsats.
Meteosat/ESA	Nov. 15	Delta	ETR	ESA meteorological satellite. Reimbursable.
CS/Japan	Dec. 8	Delta	ETR	Communications satellite for Japan, to cover telephone and color TV transmission, and experiments. Reimbursable.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title & NASA Docket	Patent No.	Installation
Richard Ravehall, Charles T. Salemme, Arthur P. Adamson; General Electric Co., Cincinnati, Ohio	Impact Absorbing Blade Mounts for Variable Pitch Blades	4,047,840	LERC
Otis S. Moreman, General Electric Co., Cincinnati, Ohio	Bearing Seal Usable in a Gas Turbine Engine	4,046,435	LERC
Charles G. Miller, Jens G. Pohl; NASA/JPL, Pasadena, Calif.	Three-Dimensional Tracking Solar Energy Concentrator and Method for Making Same	4,046,462	NRLO
Edward H. Tepper, Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn.	Regenerable Device for Scrubbing Breathable Air of CO_2 and Moisture without Special Heat Exchanger Equipment	4,046,529	JSC
John C. Freche, NASA/LERC; William J. Waters, NASA/LERC	Nickel Base Alloy	4,046,560	LERC
Robert S. Synder, NASA/MSFC; Hans U. Walter, University of Alabama, Huntsville, Ala.	Method of Crystallization	4,046,617	MSFC
Stephen H. Rice, Rodney S. Spencer, NASA/GSFC, Charles M. Fleetwood, Jr.,	Method of Treating the Surface of a Glass Member	4,046,619	GSFC
Roger L. Kessinger, Martin Marietta Corp., Denver, Colo.	Hearing Aid Malfunction Detection System	4,049,930	JSC
David K. Studenick, NASA/GSFC	Fluid Sampling Device	4,046,012	GSFC
Bruce D. Marcus, George L. Fleischman; TRW Systems Group, Redondo Beach, Calif.	Flat-Plate Heat Pipe	4,046,190	GSFC
Hubert C. Vykukal, Reginald F. King, NASA/ARC, Wilbur C. Vallotton,	Anthropomorphic Master/Slave Manipulator System	4,046,262	ARC
Otis S. Moreman, General Electric Co., Cincinnati, Ohio	Deformable Bearing Seal	4,046,434	LERC



Traffic Jam—Not your ordinary scene in the middle of the Mohave Desert, this overhead view shows some of the thousands of vehicles that jockeyed for places from which to watch the first separation of NASA's Space Shuttle orbiter from its Boeing 747 mothership. Some 65,000 visitors, plus 820 newspeople visited the Dryden center for the dramatic event which took place Aug. 12.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Physician's Modern "Black Bag"

A compact medical kit containing most of the instrumentation of a well-equipped physician's office evolved through the efforts of NASA's Technology Utilization work at the Johnson Space Center. The new concept came into being as a result of techniques and instruments developed to monitor the vital signs of astronauts during space flights. The new version of the old-fashioned physician's bag is expected to be used for diagnosis and treatment of ills or accidents that might befall Space Shuttle crews while in flight.

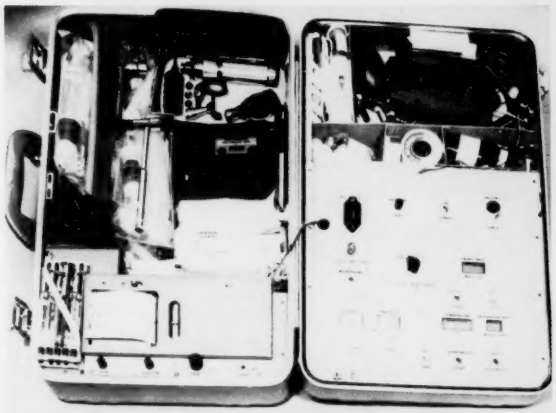
The medical bag has been a common part of a doctor's equipment for years, but its contents commonly are limited to instrument and drug supplies for on-site, more-or-less preliminary or emergency diagnosis and treatment. The heavier more complex equipment usually is available only in hospitals and doctors' offices for more extensive examination and treatment of a patient.

The NASA-developed "black bag"—though lightweight and compact—contains practically all the instrumentation of a well-equipped medical office. It weighs less than 14 kilograms.

The unit includes the electronic equipment, drugs, bandages, and instrumentation necessary for relatively thorough diagnosis and treatment of many kinds of illness or accident. It is packed into an 18-cm by 56-cm by 36-cm suitcase for hand carrying.

The electronic components include an electrocardiograph (ECG) and electroencephalograph (EEG). Data are recorded either on a built-in-strip-chart recorder or on a cassette tape recorder, and a built-in telephone coupler can be used for data transmission over a standard telephone line. A single printed circuit card is used to control the measurement and display of vital data, such as heart rate, respiration rate, temperature and blood pressure. The card is also used to precondition ECG and EEG signals for the strip-chart recorder or the telephone.

A small self-contained rechargeable battery pack supplies power for all the electronics. The battery can be used for 12 hours and may be recharged from a standard AC outlet. Battery life is enhanced in this system because the instrument data are displayed with power-saving liquid crystals.

In addition to the electronic equipment, the kit contains nearly 50 other diagnostic instruments and supplies. These include a combination laryngoscope-otoscope-ophthalmoscope, a stethoscope, an emergency supply of drugs, hypodermic syringes, thoracentesis, and spinal-puncture trays.

The advantages of the new "black bag" are many. It extends the quality of treatment a physician can administer on emergency and house calls and helps obtain more complete diagnosis prior to hospital admission. Furthermore, the electronic instrumentation is sophisticated enough to be used as part of the standard equipment in a physician's office. Work on the project was done by C. K. LaPinta and J. L. Day of the Johnson center and A. E. Schulze and G. A. Zivley of Telecare, Inc.